Climate Change Adaptation policies in Himalayan Region of Nepal. Comparative analysis of INDCs between Nepal, India, and Peru

MS-STEP Plan B Paper

In Partial Fulfillment of the Master of Science, Technology, and Environmental Policy
Degree Requirements
The Hubert Humphrey School of Public Affairs
The University of Minnesota

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12/22/2016

Abstract

The Himalayas are also known as the third pole as they comprise the third largest amount of snow on the earth after the Arctic and Antarctica. They are also known as The Water Towers of Asia. With global climate change, the temperatures on the Tibetan Plateau in the Himalayas are rising substantially compared to other regions. The Himalayan people are far from being the top contributors to this climate change, yet they suffer its hardest consequences. Studies show that communities struggle to adapt to the changing environment because of limited information, poor or no access to services, lack of infrastructure, lack of capacity on the part of the central government, an unfavorable geographical location, lack of external support etc. Hence, rural mountain communities in developing nations such as Mustang in Nepal have very low adaptive capacity. In addition to the many existing problems like poverty, the changing climate has exacerbated the numerous difficulties of day-to-day life of people in the mountains. This is just as much an environmental problem as it is a policy and social justice problem. Mustang, a mountainous district in northern Nepal, is not immune to the impact of climate change. This paper focuses on how different adaptation policies and strategies can help the Himalayan region of Nepal adapt better to the constantly changing environment and assuage the impacts exacerbated by climate change. The challenges in Nepal are not unique: other mountainous regions in developing countries have begun to develop strategies to adapt to a changing climate. India and Peru provide two useful comparative cases. Recommendations and reforms for Nepal are discussed after comparative analysis of INDCs (Intended Nationally Determined Contributions) prepared by Peru and India.

Author's personal connection to this topic

I was born and raised in a remote Himalayan village called Lo-manthang, Mustang, a culturally and geographically unique region that is often neglected by the central government of Nepal. My interest in this topic arises from direct exposure to the problems prevalent in the Himalayan region of Nepal specifically in my native land. This topic is deeply important to me personally because my family has been herding Yaks in the Himalayan regions for generations. However, it has been increasingly difficult for my family to continue the tradition due to extreme environmental conditions, new sources of risk and uncertainty triggered by climate change. It is my lifelong goal to contribute in attracting much needed attention and environmental adaptation policy to underrepresented areas in the world, including, but not limited to the Himalayas.

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Introduction

The Himalayas are also known as the third pole as they comprise the third largest snow on the earth after the Arctic and Antarctica (Sundaresan, Gupta, Santosh, & Boojh, 2014). The Himalayas are also known as The Water Towers of Asia. According to the National Oceanic and Atmospheric Administration (NOAA), the cryosphere consists of the frozen water part of the earth system, which includes ice caps, glaciers, snow cover, etc. A huge component of the cryosphere is the snow cover in the Himalayas. The Himalayan glaciers are often times used by the climate scientists as the climate change barometer, because changes in the glaciers are one of the first indicators of drastic climate change. With the increasing impact of the climate change, the Himalayan glaciers are melting at an unprecedented rate. According to the Intergovernmental Panel on Climate Change (IPCC), in the late 20th century, central Asian glaciers occupied 31,628 square kilometers. According to a report by the World Bank, there has been a very recent regional study using Climate Research Unit's reconstructed temperature dataset show that Himalayan region have warmed at higher rate than in the last century. The melting of these glaciers at the widely reported record rate has implications of severely negative consequences, which include hazards of both natural and economic origin (Xu, Grumbine, Shrestha, Erikson, Yang, Wang, & Wilkes, 2009).

There is ample literature emphasizing the scientific evidence that climate change is and will continue to pose serious negative impacts on the world's most vulnerable communities in developing nations (Gentle & Maraseni, 2012). According to the Millennium Ecosystem Assessment, climate change contributes to ecological degradation

which consequently leads to major social problems such as poverty. Some of the negative consequences of climate change result in frequent occurrence of extreme events which IPCC (2007a) identifies as glacial melts, floods, landslides, rising sea levels, water stress, typhoons, tropical storms, diseases, etc. Vulnerable areas include all of the Himalayan nations in South Asia are vulnerable, and the intensity of vulnerability can vary depending on many factors such as economic and political stability. Nepal has both, a fragile economy and an unstable government, making it more susceptible to these negative consequences (Gentle & Maraseni, 2012).

Nepal is divided into three geographical regions: the Terai Region, which is flat low-land bordering with India; the Hilly Region; and the Mountain Region, which is adjacent to the Tibetan plateau. The effects of global warming varies in the different regions. The temperature in the Mountain Region has been rising at higher rate than that of other regions as well as that of the global average over the course of last 100 years (Gentle & Maraseni, 2012). Consequently, the Mountain Region has been identified as a hotspot because of frequent change in precipitation patterns, warming, and glacial recession. These changes result in negative impacts like erratic rainfall, unpredictable monsoon season, glacial lake outburst floods (GLOF), erosion, landslides, and drought which eventually threatens livelihoods due to crop failure, food insecurity, property and livestock losses, and water stress of the people living in mountain regions (Gentle & Maraseni, 2012). Geographically, the Himalayan region of Nepal is already disadvantaged because of isolation from the central government. As a result, it tends to be

marginalized both politically and economically, making the mountain community even more vulnerable in the face of climate change (Gentle & Maraseni, 2012).

According to The World Bank, the literacy rate of Nepali was 60% in 2011. A majority of this 60% live in the metropolitan areas. The literacy rate would be substantially lower if it was exclusive to those living in the Himalayan region were included. Because of the complex topography, the Himalayan region and its people are isolated from the central government. Hence, there is disparity between the Himalayan region and the rest of the country. On the top of that, the people in the Himalayan region are disproportionally affected by the impact of climate change as they are the most vulnerable population in the country (Rai, 2012). Unpredictable climate patterns and natural disasters have made the life of people in the Himalayan nation exceedingly difficult. Farmers, in particular, are hardest hit by series of events that are very likely linked to climate change. This is giving rise to a lot of other social issues. The number of farmers abandoning their livelihoods and their homes to relocate, either to the cities or to gulf countries, is increasing every day. At one time, Nepal exported food and raw materials to India and Bangladesh. Today, it struggles to provide for its own people. In 2010 alone, Nepal imported 316,000 tons of food, a number that is likely to grow (Liu, 2013). Besides agriculture, the Himalayan region plays a very important role in supporting the economy in various other ways: hydropower, water supply, and tourism (Gautam, Timilsina,&Acharya, 2013).

Furthermore, climate change has a negative impact on the cultural life of indigenous people who have been calling the mountains their sacred home for generations. The

people living in Himalayan region are predominantly Tibetan Buddhist, and their life style is vastly different from the rest of the country. Biological diversity plays a key role in their mere existence: for example, most of the conventional medicinal herbs they use are grown in high altitudes. They are very spiritual and maintain a special relationship with the nature. In August 2011, BBC ran the story "Buddhist village in Nepal at risk of being swept away", because the 11th century monastery (a key part in the village's identity) is increasingly becoming more susceptible to a catastrophic flood (Khadka, 2011). The impacts of climate change are therefore threatening not only their occupation but also the very identity, existence, customary practices, religion, and culture of the Himalayan people (Rai, 2012).

Literature Review

IPCC claims that research has shown that greenhouse gases (GHGs) emissions from human activities over time are already changing the earth's climate and emission reduction alone is no longer enough to minimize the impact of human-induced climate change. Climate scientists realize that, even in the best-case scenario, emission reduction will have little effect on climate impacts over the next several decades (Amaru & Chhetri, 2013). In recent years this has prompted a resurgence of increasing interest in adaptation to climate change and attention has increasingly focused on giving adaptation a more central role in the international response to climate change, especially in the United Nations Framework Convention on Climate Change (UNFCCC) (Aalst, Cannon, & Burton, 2007). Adaptation which is still very much at its nascent stage started as a complement in the face of climate change after mitigation. According to the Human

Development Report (2007/2008), adaptation is an integral component of sustainable development, reducing vulnerability, and implementing development initiatives (Kelkar & Bhadwal, 2008). Furthermore, because future environmental risks are more apparent and frequent than ever, adaptation has become a staple element in climate change (Nelson, Adger, & Brown, 2007). In terms of climate risk management, adaptation is extremely important for improved preparedness.

According to IPCC, adaptation is defined as "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC 2007). Investigating the scope of adaptation unequivocally emphasizes the aspect of scale of the adaptation. The scale at which adaptation occurs is vital in identifying the best adaptation policies and strategies. Aalst et. al, defines adaptation at the community level as an ability to maintain or preferably improve the current living standards in the face of climate change (Aalst, Cannon, & Burton, 2007). For the purpose of this paper, the scale of interest is at a regional or at community level (Himalayan Region) in the context of development. Ford et. al, claims many adaptation measures are best at the national level for reasons such as accountability and effectiveness since the national government is a central pivot (Ford, Berrang-Ford, Lesnikowski, Barrera, & Heymann, 2013). This is a cogent argument if the country has highly functional adept central government with stable political environment. However, for a country like Nepal with a highly unstable and precarious political environment, adaptation at regional level is better than at national level.

A successful adaptation, whether at a regional, national, or international level is contingent upon many factors. The most important of these is the understanding of the nexus of adaptation, vulnerability reduction, and development. Adger defines vulnerability as the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt (Adger, 2006). There are numerous controversies in academic literature regarding adaptation and vulnerability and whether adaptation should reduce vulnerability or vulnerability should be reduced first to make way for a successful adaptation. For a successful adaptation it is important to integrate strategies involving both adaptation and vulnerability for short-term and long-term impacts. According to Lisa & Schipper, adaptation is a process to reduce impacts and not vulnerability (Lisa & Schipper, 2007). As baffling as it may sound, understanding the role of development certainly helps in unraveling this conundrum. Focusing on sustainable development to reduce vulnerability to climate change (how to approach this is beyond the scope of this paper) is vitally important, and that will subsequently translate into a successful adaptation (Lisa & Schipper, 2007). Expanding the meaning of adaptation only in context of climate change may not result in desired outcome. It is imperative to take a new holistic approach on adaptation in the context of development by addressing vulnerability reduction.

The definition and meaning of adaptation may vary by subtle differences as it is interconnected with long and multidisciplinary history of investigation (Moser & Ekstrom, 2010). Hence, given the fickle nature of adaptation and its complex dynamics and need to be location-specific, there is more than one way of defining it. For the

purpose of this paper, I will be referencing the definition by IPCC. The broad discussion of adaptation can be established in the context of both developing and developed nations. The impacts of climate change are disproportionate on developing nations because of the varying ability to respond. Developed nations are not struggling as much as developing nations in combating the challenges posed by climate change. Therefore, adaptation to climate change is especially relevant to developing nations in juxtaposition to developed nations. Developed nations have better adaptive capacity and thus seem to focus more on adaptation strategies that respond to expected climatic stress in the near future. On the other hand, adaptation in developing nations seem to respond to already imposed consequences as well as future changes. Even within a country, whether developing or developed, the analysis of adaptation widely varies on scale depending on rural or urban settings. Furthermore, the altering and unpredictable nature of adaptation requires that it is conditioned by the context of governance to be successfully and effectively implemented (Amaru & Chhetri, 2013). For a successful adaptation plan, it is important that it is feasible to the respective community; plausible technically and environmentally; and supported by the existing policies, law, rules, regulations, programs, and mandates (Amaru & Chhetri, 2013). Adaptation can occur at local, regional, national, or international levels.

The application of different types of adaptation is dependent on the objective, scale, and capital investment of that specific adaptation plan (Gentle & Maraseni, 2012). For instance, if the adaptation is autonomous or reactive, then it is most likely to be adopted by small rural communities that are resource-dependent in response to short term events.

Generally, these types of adaptation will be suitable for socio-economic sectors that have little to no capital investment. On the contrary, planned and strategic adaptation is more suitable for long term goals and where the capital investment is relatively high. According to IPCC, evidences are emerging that specify the urgent need of adaptation policies and strategies in developing countries (IPCC, 2007b). Six types of adaptations recognized by IPCC 2001 are given below:

- Anticipatory adaptation: Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
- Autonomous adaptation: Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
- Planned adaptation: Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.
- Private adaptation: Adaptation that is initiated and implemented by individuals, households or private companies. Private adaptation is usually in the actor's rational self-interest.
- Public adaptation: Adaptation that is initiated and implemented by governments at all levels. Public adaptation is usually directed at collective needs.
- Reactive adaptation: Adaptation that takes place after impacts of climate change have been observed.

When it comes to adaptation, one size certainly does not fit all. Some types of adaptations will be suitable for developing nations, while others will be suitable for developed nations. Different modes of adaptation are likely to be used for different countries. For developed countries, anticipatory, planned, and public adaptation are more likely, as they are more fitting. The consequences of climate change are less evident, as developed countries are well equipped and thus have a better adaptive capacity. In essence, the need for adaptation in developed countries is not as dire, as they are more precautionary, as opposed to reactive. On the contrary, the need for adaptation in developing countries is relatively acute and urgent. The adaptive capacity of developing countries is reduced because of limited information, poor or no access to services, lack of infrastructures, ignored by central government ignorance, unfavorable geographical location, lack of external support, etc. Most of the adaptations occurs on an individual level, as they are simply reacting to the invariably changing environment. Hence, autonomous, private, and reactive adaptations are more likely to be used in developed countries. It is important to understand that developing countries are not in a position to impose anticipatory, planned, public adaptation, because they are compelled to act immediately, whether to make ends meet or solely for survival. However, once they are in a better position, they can take approaches that are more suitable for long-term adaptation, such as in developed countries. However, they must first be caught up in reacting before they can begin planning. The success of adaptation is tricky, and the proper assessment is only suitable in long-term adaptation. What may seem to be a successful adaptation strategy in the short term may be maladaptive in the long-term. Long-term planning is not as viable for developing countries when they are desperately trying to react while simultaneously

planning for future. This is not to imply that short term is inappropriate. The best way would be to integrate both short and long term concerns and tackle jointly.

Adaptation to climate change is definitely a nascent, yet not altogether a well-established, concept. Unfortunately, it will continue to be so, because of its dynamic nature. It will continue to change with shifting socio-economic, technological, and resource regimes over time (Amaru & Chhetri, 2013). The concept of adaptation came into light as a reaction to the negative consequences of climate change. Today adaptation is considered as one of the most effective mechanism in response to complex dynamics of climate change compared to mitigation especially in context of developing nations. It was only recently that adaptation was considered a taboo subject in debate of global climate change, as it is believed to undermine efforts to reduce GHGs emissions (Amaru & Chhetri, 2013). This can and has led to moral hazards and hence, in the international arena, mitigation and adaptation has become more of a political dispute than environmental.

When adaptation was starting to be considered a fitting mechanism in response to climate change, the initial approach to it was predominantly a top-down approach one. The logic behind this concept was that climate change was considered to be a global environmental pollution problem (Aalst, Cannon, & Burton, 2007). As the name suggests, this approach begins with climate change scenarios derived from Global Climate Models and is then scaled down to regional scenarios and eventually applied to a specific target (Aalst, Cannon, & Burton, 2007). During its inception, this worked very well and contributed to

theoretical understanding of potential climate impacts. However, over time, it was apparent that this approach was not wholesome, as it only provided a simplified characterization while missing many others. In addition, it focused on future climate, which is uncertain and left numerous unanswered questions.

The dissatisfaction and criticism of top-down approaches created opportunities for bottom-up approaches. Bottom-up approaches are aptly named, as they are potentially complimentary of the top-down approaches: they work their way up from the bottom, most likely from local scale to eventually international level. Bottom-up approach is further explained in detail in the Adaptation Policy Framework for Climate Change by UNDP in 2005. Bottom-up approaches have two dimensions that somehow fills the voids for which top-down was heavily criticized. Unlike in the top-down approach, this approach involves local stakeholders, and the assessments examine vulnerability to current climate variability and extremes based on actual experience at different scales, as opposed to focusing on an uncertain future (Aalst, Cannon, & Burton, 2007). Whether it is through a top-down or a bottom-up approach, given the intricate nature of adaptation that requires a multitude of stakeholders, it is not appropriate to focus solely on one approach, as they are likely to overlap. Conversely, integration of those two approaches will have the benefit of shared resources, information, and aspiration (Amaru & Chhetri, 2013).

Even though adaptation has been a hot topic in recent years, there are still a relatively few peer-reviewed case studies that document climate impacts on human systems and

adaptation actions in the mountain region (McDowell, Stephenson, & Ford, 2014). There has been some success in terms of developing local and national adaptation plans. However, knowledge of the state of climate change adaptation in these regions is still very limited (McDowell, Stephenson, & Ford, 2014) and this could hinder the effectiveness of adaptation plans on different scales upon execution. While reports of local/regional cases of specific populations or sectors are readily available and make up majority of studies, there has been very little scholarly work on core details like identifying, characterizing, and synthesizing insights about human dimensions and adaptation across mountain regions (McDowell, Stephenson, & Ford, 2014). Another study that focused on emerging literatures tracking on-ground adaptation process found out that there is very little scholarly literature on adaptation beyond community scale (McDowell, Stephenson, & Ford, 2014). This type of information is crucial in exchanging insights among different regions facing similar or related climatic stresses, thus helping design adaptation plan and even shaping policy. Adaptation is great mechanism with which we can deal with climate change, but it is also very complex. If cautious measures are not taken, adaptation can quickly become maladaptation. IPCCC defines maladaptation as "any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing impact but increases it instead".

Methodology

According to a systematic literature review of the recent English language peer-reviewed scholarship on adaptation in glaciated mountain regions, 4050 potentially relevant articles

were examined, with 36 included for full review (McDowell, Stephenson, & Ford, 2014). Results indicate that scholarly investigation into adaptation in glaciated mountains is presently limited to only 40 % of countries with alpine glaciation. Seventy-four discrete adaptation initiatives were identified, with most occurring in Peru (28 %), Nepal (22 %) and India (17 %). The two most climate change-vulnerable mountain regions are the Andes in South America and the Himalayas in South Asia both of which were included by selecting India and Peru. All three countries are highly prone to earthquake. In addition, a list of indicators is also considered while selecting countries for this study. Further indicators to conduct a good comparative analysis on these three countries are given below:

Table 1: List of indicators for comparative analysis of Peru, India, and Nepal

Peru	India	Nepal
GDP Ranking = 53rd GDP per capita = $6121.9 HDI = 85th Democracy Index = 75 Gender Gap Ranking = 89 Corruption Perception Index Ranking = 88 Percentage of rural population = 30%	GDP Ranking = 9th GDP per capita = $1581.6 HDI = 130 Democracy Index = 35 Gender Gap Ranking = 108 Corruption Perception Index Ranking = 76 Percentage of rural population = 70%	GDP Ranking = 107th GDP per capita = $732.3 HDI = 145 Democracy Index = 124 Gender Gap Ranking = 110 Corruption Perception Index Ranking = 130 Percentage of rural population = 80%
Population = 30 mil 0.43% of world population 0.3% share of global emissions	Population = 1.25 bil. 17% of world population 5.8% share of global emissions Indian Himalaya = 31 mil (3.73 % of total population)	Population = 28.17 mil 0.39% of world population 0.027% share of global emissions
Mountain Range = Andes	Environmental Categories = Himalayas	Environmental Categories = Himalayas

Agrarian Country	Agrarian Country	Agrarian Country
Climate Risk Index Rank by German Watch #50	Climate Risk Index Rank by German Watch #17	Climate Risk Index Rank by German Watch #19
Most affected people = indigenous people	Most affected people = indigenous people	Most affected people = indigenous people

India

India is gifted with many major rivers, majority of which originate in the Himalayas, including the Brahmaputra and Ganges. The snow and ice melt of Himalayas feed these rivers, and more than 50% of the water resources of India are from the tributaries of these rivers. The average water yield per unit area of the Himalayan rivers is twice as many as those of the south peninsular river system, indicating the importance of snow and glacier melt from the Himalayas. The river and underground water in India are the source of prosperity for the majority of its population, especially for those in the rural agriculturally-oriented areas. As much as 84% of the available water in India is used for agricultural purposes alone.

According to a study undertaken by the Ministry of Environment and Forests, Government of India, the impact of climate change on the water resources in Indian river systems is the leading cause of water scarcity. In addition to the natural stresses, India faces additional problems to which Peru and Nepal may not really relate. Due to rapid urbanization, extensive land use, agricultural expansion, increasing population, rapid industrialization, and economic development, the demand of water in India has already increased exponentially in recent years, exacerbating an already difficult situation. In

addition, the increased population will likely require more energy, freshwater, and food, which again will heighten the water crisis, as there will be increasing water demand in other sectors, as well. Hence, there is overexploitation of water resources in India as a result of human activities. Increased demand of water will also cause conflict in different types of water usages. Not only has it hiked the water demand, but it has also posed a serious threat of natural disasters. The mountainous region of subcontinent India is of particular concern, as the most prominent effect of global warming has been noticed in glacier melt. Consequently, distinguishing the cause of water stress problem is a genuine challenge. It appears to be an amalgamation of both, but the problem advances when it is not clear which one is contributing more and to what extent. The obscurity of the role of climate change in water stress has left the water planner and agencies with no incentives to incorporate the impact of climate change into their future projects and water resources management systems. Hence, the failure to sustainably manage the integrated water resources will accrue to a huge opportunity cost to India. This may hinder the much-needed progress in socio-economic development of the country.

According to IPCC, there is general impact of climate change on the intensification of the global hydrological cycle affecting both groundwater and surface water supply. Despite the effect on frequency and intensity of precipitation, the impact of climate change also depends on both the existing condition of water management systems and the ability to respond. Hence, the impact of climate change is going to be most severe in developing countries that are unable to adapt.

Peru:

The central Andes mountains are home to more than 99% of the world glaciers in the tropical latitude and are spread through five different countries in South America: Peru, Bolivia, Ecuador, Colombia, and Venezuela. Peru has 70% of the glaciers, Bolivia has 22%, Ecuador and Colombia each have 4% each and Venezuela has 0.1%. Peru is primarily home to the tropical glaciers, thus, Peru's climate is most strongly defined by the Andes mountain barriers. The glaciers in this region not only serve as a primary water sources associated with economic activities, but they also play a very important role in customs and cultures of the indigenous people living near or those that are dependent on these water sources. Peru is divided into three main regions: the coastal strip, the Amazonian plain, and the mountainous region of the Cordillera of the Andes. The distribution of population is very uneven, since approximately one-half of the population is living on the coast and one-third is living in the Cordillera. Hence, there are acute differences in levels of access to water resources throughout the country.

Intended Nationally Determined Contributions (INDCs)

In December 2015, countries around the world stood united with a common goal to reduce greenhouse gas emissions. About 200 UN delegates representing countries across the globe gather to adopted an historic international climate agreement at the UNFCCC. Participant countries publicly outlined their Intended Nationally Determined Contributions (INDCs) under the new international agreement. INDCs primarily reflect the ambition of each country to reduce emissions, but some countries including Peru, India, and Nepal, also address their climate change adaptation strategies. The

comparative analysis of the INDC proposals of these three countries will be crucial in formulating reforms and recommendations for the Government of Nepal with emphasis on Himalayan region.

Table 2: Descriptive information of Peru, India, and Nepal

	PERU	**INDIA**	**NEPAL**
Problem and relation to Climate Change	0.3% share of global emissions. Among the most vulnerable countries to the effects of climate change. Increase in average temperature Glacier snout retreating, shrinking of accumulation area, increase in ablation area, and decrease in total surface area of glaciers, and GLOF Extreme weather events: drought, rain, floods, heat waves, frost etc.) Water stress: sea level rise, river runoff, drinking water, sanitation, agricultural, mining operations, and hydropower station. Degradation of ecosystem Livelihood of farmers, livestock and indigenous people. 30% rural population Tourism industry negatively impacted Amplification of seismic ramification	5.8% of global emissions. Among the most vulnerable countries to the effects of climate change Increase in average temperature Extreme weather events: drought, floods, heat waves, etc. Water stress: sea level rise, surface and ground water scarcity, river runoff, sanitation, agricultural, industrial operations. Degradation of ecosystem Livelihood of farmers, livestock and indigenous people. 70% rural population Amplification of seismic ramification	Only 0.027% share of global emissions. Among the most vulnerable countries to the effects of climate change. Increase in average temperature Glacial retreating, shrinking, rapid melting, and GLOF Increase in frequency of extreme weather events: landslides, floods, and droughts. Water stress: river runoff, agricultural, and hydropower station. Degradation of ecosystem. Livelihood of farmers, livestock and indigenous people. 80% rural population Tourism industry negatively impacted Amplification of seismic ramification

Existing major programs	Development of two national communications complying the UNFCC guidelines to tackle climate change. The National Climate Change Strategy (NCCS) initiated in 2003 and amended in 2009 with a goal to alleviate impacts of CC via integrated focus on vulnerability and adaptation on national, sectoral and regional levels. National Adaptation Plan led by Ministry of Environment under the National Commission on Climate Change.	The National Environment Policy (NEP) laid down the broad policy framework on environment and climate change with an objective to promote sustainable development while encompassing ecological conservation and social justice values The National Action Plan on Climate Change (NAPCC) under the Ministry of Environment, Forest, and Climate Change and the Prime Minister's Council on Climate Change with an objective to address climate change by focusing on mitigation and adaptation. The State Action Plan on Climate Change (SAPCC) are initiatives at state level to combat climate change that comply heavily to the NAPCC.	National Adaptation Program of Action (NAPA) launched in 2011 under Nepal Ministry of Environment. Local Adaptation Plan for Action (LAPA) after succession of NAPA NAPA and LAPA objective to endorse climate change policy and integrate climate change adaptation and resiliency in local and national plans. Nepal Climate Change and Development Portal
Top 5 Priorities sectors in adaptation strategies	Water Resources, Agriculture, Fishery, Forestry, and Health	Agriculture, Water, Himalayan Ecosystem, Forestry, Capacity building and Knowledge Management	Institutions, Policies, Strategies, and Framework Adaptation Actions Knowledge Management Mitigation

Intended National Determined Contribution (INDC)	The INDC proposal in adaptation submitted by Peru is built on the progress made already till date. The adaptation component is amended and formulated for different sectors and prioritized systems. The goal remains the objective for 2030 which is to achieve 30% reduction in emissions by 2030 by adapting to adverse effect and capitalize the opportunity presented in the process. Five crosscutting areas identified to take action in order to execute climate change adaptation successfully are: 1. Disaster Risk Management 2. Resilient Public Infrastructure 3. Poverty and Vulnerable Population Approach 4. Gender and Intercultural Approach 5. Promotion of private investment in adaptation	The INDC proposal in adaptation submitted by India clearly emphasizes the country's interest in economic development but coupled with agenda to eradicate poverty and commitment to lower carbon emission via advanced clean technologies and support from the rest of the world. The target goal is to reduce the emission by 33-35% of emission by 2030 from 2005 level. Unlike Peru, India's intended contribution is rather obscure with equivocal focus: 1. Achieve healthy and sustainable way of living focusing on conservation and modernization. 2. Climate friendly and cleaner path to achieve economic development. 3. Achieve 40% of electric power from clean energy sources by 2030. 4. Create additional carbon sink. 5. Better adapt to climate change by encouraging investments in development programs in priority sectors mentioned earlier. 6. Mobilize domestic and international funds to fund mitigation and adaptation initiatives.	The INDC proposal in adaptation submitted by Nepal is contingent on the past progress laid out by NAPA and LAPA. Because of the earthquake, the country's already crippled economy is further weakened and could be the reason for impeding progress. However, the intended contribution is listed below and they seem very feasible with support from developed nations. 1. Promotion of renewable energy technologies, water conservation, and greenery development villages. 2. Undertake advanced approaches (bio-physical and social science) to better understand the impact of climate change in all regions: Hills, Terai, and Mountains in order to develop suitable adaptation strategies. 3. Formulate the Low Carbon Economic Development. 4. Achieve 80% electrification by renewable energy sources by 2050. Reduce dependency on fossil fuels. 5. Develop electrical(hydropower) rail network by 2040 to support mass transportation and commuting. 6. Maintain 40% of total

			area of country under forest cover and give emphasis to carbon sequestration and forest carbon storage.

Climate Change Problems

The negative impacts of climate change are undeniably felt across the globe; No country is immune to them. Nevertheless, some developing nations are more vulnerable, whereas developed nations are better equipped to mitigate the impact. The Himalayas in India and Nepal and the Andes in Peru are both very susceptible to the global climate change, which places them among the most vulnerable countries to the effects of climate change. Increases in the average mean temperature trigger frequent and intense weather events such as floods, droughts, and rainfalls. These extreme events not only put lives in danger, but they also pose serious economic losses as well. The Andes and the Himalayas are home to a majority of the world's glaciers. The increase in average temperature has

caused these glaciers to shrink, ablate, and overflow, resulting in Glacial Lake Outburst Flood (GLOF). GLOF has potential to wipe out livestock, cause huge economic distress, and claim countless lives. It is important to note that water stress is one of the most pressing issues triggered by climate change. Lack of water for not only drinking, sanitation, and irrigation, but also for large-scale operations including mining, hydropower, and other industries, has major economic implications. The stress of water is felt more severely in rural regions where people depend on agriculture for livelihood. 70%, 80%, and 30% of the population of India, Nepal, and Peru, respectively, live in rural areas. Tourism is a flourishing industry for Nepal and Peru, but it is currently plunging as the extreme weather events become more frequent and the danger of GLOF surges.

Most of energy in India is sourced by coal, but in Peru and Nepal primarily use hydropower as their energy source, and thus are even more so negatively impacted by water stress. Each of these countries are actively prone to earthquake. It is very clear that the ramifications of earthquakes, are amplified by climate change and vice-versa. When an earthquake strikes Peru, however, the ramification is never as intense as in Nepal. Peru is evidently better prepared for disasters, and perhaps Nepal could follow Peru's path in disaster preparedness. When a country with significantly less contribution to the problem is hit harder than a country that has relatively contributed more, it raises concerns over justice issues. Peru and Nepal are both small countries with population of less than 30 million people or less. Both countries have low per capita emissions and contribute 0.3% and 0.027% of global carbon emissions respectively, whereas India is a much larger

country with rapid economic growth, which also contributes 5.8% of the global emission. Nonetheless, these countries are more vulnerable than most countries, and financial help from developed nations and international organizations like United Nations would help in strengthening and sustaining their effort to be more resilient.

Existing Programs

While many countries have introduced programs designed to tackle environmental problems for many years. It is quite clear that most the programs focusing on climate change adaptation are relatively new. In India, the Ministry of Environment, Forest and Climate Change (MoEFCC) is the principal agency responsible for any kind of planning, designing, promotion, management, administration, or implementation regarding and relating to environmental programs. In 2006, The National Environment Policy (NEP) laid down the broad policy framework on environment and climate change with an objective to promote sustainable development while encompassing ecological conservation and social justice values. The NEP is not completely original; rather, it built on the progress in earlier policies laid out by the collaboration of several agencies both at national and state levels.

On 13th July 2007, India compiled the National Action Plan on Climate Change (NAPCC) under the Prime Minister's Council on Climate Change with a goal to address the impacts of climate change. In addition to addressing climate change challenges, a goal of NAPCC is also the advancement of the development of both mitigation and adaptation while yielding the co-benefits in the process. Co-benefits are the intended and

sometimes unintended positive effects. The published technical document on NAPCC is very clear on the interest of Indian government in rapid economic growth, as it can help to alleviate poverty, which consequently would improve the quality of life and hence minimize the population's vulnerable to the impacts of climate change. The NAPCC focuses on providing a roadmap for required intervention to outline the priorities for mitigation and adaptation as an effort to combat climate change on a national level. Those initiatives are supplemented by actions of a broad range of stakeholders that includes the State Governments, Non-Governmental Organizations (NGOs), research institutes, private sectors, etc. The State Action Plan on Climate Change (SAPCC) includes initiatives at the state level to combat climate change that comply heavily to the NAPCC. At the present time, a majority of the States in India comply with SAPCC.

Until recently, there was no considerable national effort by Nepal to establish of climate change adaptation policy. Climate change policies have received positive and high-level political support, which led to many national level policies (Regmi & Bhandari, 2012). In recent years, numerous institutions, both governmental and nongovernmental, committed to tackling climate change issues at local, regional, and national levels have been established. The launching of National Adaptation Program of Action (NAPA) is the most crucial step in that endorsed climate change policy (Nepal Ministry of environment, 2011). In addition, the government established a climate change council under the leadership of the Prime Minister giving the Ministry of Environment the authority to approve climate change policy (Regmi & Bhandari, 2012). The positive response of the national effort in addressing climate change policy has resulted in the establishment of

frameworks at the local level, as well. To further support the implementation of adaptation policies acknowledged by NAPA, the government established the Local Adaptation Plan for Action (LAPA) (Nepal Ministry of Environment, 2011). LAPA was established with the goal of integrating climate adaptation and resiliency in both local and national plans.

Nepal and India have national adaptation policies that were introduced in past decades; Peru, on the other hand, is currently in the process of formatting one. Peru's National Climate Change Strategy (NCCS) was initiated in 2003 with an objective to alleviate the impact of climate change by focusing on vulnerability and adaptation on regional, state, and national levels. NAPA in Nepal has similar goals to tackle the impacts of climate change, focusing on climate change policy and integrated climate change adaptation and resiliency in local and national levels. However, India's NAPCC has a slightly different goal, focusing on mitigation and adaptation while still surrounding on economic development. India has been emphasizing their economic interest and its precedence over anything else.

The COP21 agreement has had a very positive influence on adaptation policies in countries around the world. Post COP21, Peru has been getting serious about expediting their National Adaptation Policy, along with the help of several foreign agencies. The historic international climate agreement at the UNFCCC includes the obligation of member countries to publicly outline their post 2020 climate actions, which is known as Intended Nationally Determined Contributions (INDCs). Peru's INDC will likely play a

major role in developing and expediting their National Adaptation Plan. India already has adaptation plans in place, both at state and national levels, while Nepal has adaptation plans already in place at national and local levels. Whether Peru moves forward with the NAP is yet to be seen.

Top Priorities Sectors in Adaptation Strategies

Peru, India, and Nepal are all UNFCCC member countries and they have submitted their INDC proposals. All three countries have been fairly clear with their adaptation strategies and have successfully laid out their priority sectors. While Peru and India have very similar sectors that they want to address on a priority basis, Nepal's strategy is quite different. Peru has determined that the vulnerable populations are of the highest priority and should be considered accordingly. Peru's vulnerable population consist of people living in rural areas including indigenous people. These populations usually depend on subsistence family farming, fishery, and they are most likely to be isolated from the cities. Therefore, Peru's strategy of policies toward the most vulnerable demographic groups and sectors has maximized the potential effectiveness of climate adaptation. India has prioritized climate adaptation similarly, focusing on the most vulnerable populations and to comply with the NAPCC. Meanwhile, Nepal, despite having developed a policy framework, has not successfully prioritized adaptation for its most vulnerable populations, the people in the Himalayan regions.

INDC Proposal in Adaptation

The INDC proposal in adaptation submitted by Peru evidently demonstrates their seriousness in amending the existing adaptation strategies. While the ultimate goal is to reduce emissions by 30% by 2030, their focus on adaptation is vigorous. The intermediate goals are to increase the availability of water, reduce the negative impacts of climate change on the agrarian activities, reduce vulnerability of the fishery industry, promote comprehensive land management, increase the resiliency of vulnerable population and minimize the health effects triggered by climate change. Even though the rural population is only 30% of the country's total population, Peru's national agenda for rural areas is commendable. Peru has been focusing on projects that work specifically with rural communities, which includes the indigenous community. Practical Action has initiated number of projects in Peru for years and analyzing those projects clearly indicated that a specific focus on rural areas is urgently required for a national agenda to be successful (Clements, Cossico, & Ensor, 2010).

Peru's crosscutting goals still remain very ambitious by focusing on critical issues. Disaster risk management is achieved through close monitoring of all the districts prone to disaster, education, and increased awareness through technical skills. Since Peru is prone to disaster, the government has been actively focusing on developing and rectification of its disaster risk reduction policies and procedures. Consequently, this led to a new law on disaster risk management that established a comprehensive National Disaster Risk Management System (World Bank, 2016). One successful example of disaster risk management system is the Glaciers Project that was carried out to reduce

risk of GLOF in Cordillera Blanca in Peru. The project implemented three strategies: knowledge generation, increased technical and institutional capacity, and institutionalization of risk management. Consequently, both the people and the authorities in Corillera Blanca seem to have improved their resilience to glacial lake hazards as the casualties and damages of structures are relatively minimized compared to previous disasters. (Munoz. et al, 2016).

Steering private investment in adaptation programs is also an effective way to draw more financial leeway to introduce innovative mechanisms that will increase the resiliency of vulnerable communities and systems. India has promising opportunities for renewable energy (solar and wind) and with little help from international agencies like Green Climate Fund (GFC). GCF helps developing countries tackle climate change by supporting projects, programs, and policies. Even though the primary focus of GCF is mitigation, but the same fund also supports adaptation. Multilateral funds are available through GCF and India has the capacity to tap into them for adaptation agendas. Collaborating on projects and working together toward a common goal is something India has planned, especially when cutting edge climate technology, and expensive research and development projects are concerned. This is something all developing nations envision, as they do not have the capacity to execute on their own due to financial barriers and lack of technology, information, and well-trained workforce.

According to FAO, microfinance institutions and commercial banks are extending their services to farmers in rural areas in several developing countries. In developing countries, agricultural insurance in response to climate change, also referred to as climate

insurance, is a brand new concept. With more private, public, and international investments, climate insurance mechanisms can be established in developing countries to cover a whole spectrum of weathershocks. In recent years, Indian government has implemented climate insurance at both the micro level (in order to support small households) and at meso level (in order to help rural financial institution level) (Mahul & Stutley, 2010). These insurance programs have played major role in providing food security to farmers and reducing vulnerability to the impact of extreme weather events. The index-based livestock insurance project by World Bank in Mongolia has been successful in reducing the impact of livestock mortality and improving herder's livelihoods (Mahul & Skees, 2007). These efforts have proven to be instrumental in providing financial stability, reducing vulnerability, and improving the lifestyle of the people of India and Mongolia.

Once again it is strongly evident from the INDC proposal that India's top priority is economic development, but they are optimistic that it can be done while focusing on the eradication of poverty coupled with low carbon progress. To further echo the commitment, the government of India has set up its own National Adaptation Fund with an amount of Rs. 3.5 billion ($52.8 million) for next two financial years. There has been multiple international controversies declaring that the funds are inadequate, given the country's contribution in global emission, population, and challenges the country faces. Nevertheless, it is a positive gesture. Neither Peru nor Nepal has been able to set up any Adaptation Fund. Unlike Peru, India's strategies are rather equivocal, as the contributions listed are at best more general. India is straightforward in their laying out of plans on achieving a sustainable way of living via conservation and modernization, adopting a

climate-friendly path to achieving economic prosperity, but they lack clarification on how best to approach. Thus far, India has seen some successes in water conservation via rainwater harvesting. According to a detailed district and agro-ecoregional level study in India by United Nations Environment Program (UNEP), as high as 50% of water used in irrigation can be achieved from harvesting rainwater (Rebecca et al, 2011).

For agrarian countries like India and Nepal, where a majority of the population lives in rural regions, there are numerous sophisticated traditional agricultural systems that are passed down for hundreds of generations. With improved agricultural technology, some of these traditional agricultural systems could prove to be ecologically sound and sustainable. The raised field distribution in Peru's Titicaca Basin is a classic example. The research and experiments in Peru demonstrated that the new technology in conjunction with conventional farming practices can be very effecting under changing climate (Erickson & Chandler, 1989). Emphasis should be given to research and experiments that could lead to such innovations. It will be worthwhile for Nepal and India to examine some conventional agricultural practices to become resilient and adapt better to the constantly changing environment.

Nepal's INDC proposal in adaptation is contingent upon foreign aid. Nepal has already initiated National Adaptation plans, but it lacks the resources to execute. After the disastrous earthquake, Nepal's crippled economy is further weakened, leading to the financial crisis. With such financial difficulty, it is apparent that Nepal is now depending on foreign aid more than ever before. The plans laid out in Nepal's NAPA promote

renewable technologies in villages to strengthen implementation of an environmentally friendly framework. These plans compliment well the objectives of climate change adaptation, but at the moment, this complement appears highly unlikely without support from international agencies and developed countries. One thing Nepal has highlighted in the proposal is the need for advanced and better approaches to scrutinize the impact of climate change in the Himalayan, Hills, and Terai region.

Through collaboration with international agencies, institutes, and research organizations this is achievable. Agricultural research institutes, technological companies, and academic institutions can play major roles in helping developing countries become more resilient (Ortiz et al, 2007). With support from international donor communities, India has successfully implemented many activities in plant genetics. The National Agricultural Research System (NARS) of India has been carrying out several projects to develop flood and drought-tolerant crops for different regions. The production of cotton in India is an illustrative example. India produced over 5.1 million tons of cotton as opposed to its pre-Bt (Bacillus thuringinesis) production of 3 million tons (Karaba et al, 2007).

Along with the rest of the world, Nepal too plans to formulate a low Carbon Economic Development Strategy with focus on energy, agriculture and livestock, forest, industry, transportation and commercial sectors. However, this is a whole new concept to Nepal, and it will need notable assistance from foreign agencies and countries. Nepal's major source of energy is hydropower and while Nepal has potential to make use of this, it lacks infrastructures. Achieving 80% electrification through renewable energy sources is very

ambitious, but with proper planning, funding support, and collaboration it is achievable. Deforestation is one of the major problem in Nepal, and to maintain 40% of total area of country under forest cover and enhance carbon sequestration and carbon storage is noble plan but not easily achievable.

Nepal has proposed a very ambitious set of plans, and they will certainly benefit the country, and namely the vulnerable population. However, it also requires a substantial amount of international aid. Fortunately, there are agencies for this exact reason, including The Adaptation Fund and the Green Climate Fund. The Adaptation Fund is a byproduct of the Kyoto Protocol of the UNFCCC. Since its inception in mid 2000s, the Adaptation Fund has been very successful in helping developing countries combat and adapt to climate change. According to its official website, the Adaptation fund is financed by various sources, including the government, private donors, and Clean Development Mechanism. The Green Climate Fund (GCF) is another example of such international cooperation aiding developing countries' fight to adapt to climate change. According to its official website, GCF is a global initiative established by 194 governments to help the vulnerable communities in developing countries to the inevitable impacts of global climate change. Hence, developed countries can help developing countries to adapt via organizations like the Adaptation Fund and the Green Climate Fund by providing financial assistance. However, fundraising alone is not enough. Nepal has to be prepared and know how to make best use of those funds. India's plan is contingent to foreign aid as well, and that can be an opportunity for country like Nepal to learn.

POLICY RECOMMENDATIONS

Based on a comparative analysis of adaptation policies and practices that have worked well in the comparable mountainous regions of India and Peru, below are some policy recommendations to strengthen the climate change adaptation policy in Nepal.

- **Policy to address a national agenda for rural areas.** The whole Himalayan region in Nepal is rural. The region is often neglected because of its challenging geographical location and isolation from the central government. The existing policies are not appropriate for rural areas, especially the Himalayan region. Hence, the issues prevalent in the Himalayan region are not addressed. There should be policy addressing the issues of rural areas. In Peru several projects relevant to rural areas like sustainable resources management, food security, and disaster management have proven to very successful in reducing vulnerability of the rural people including the indigenous community. They have played major role in strengthening the national policy as well. Comprehensive inclusion of rural areas in national agenda in Nepal will bring the much-needed attention to the Himalayan region, as similar inclusion in Peru.

- **Revise NAPA and LAPA to be more resource-sector specific. Inclusion of local people in decision-making.** Nepal's NAPA and LAPA were designed and deployed back in 2010 and 2011, respectively. However, there is not much implementation occurring at the present time. Peru still doesn't have a NAPA while India does. India's SAPCC is very thorough, and Nepal should discern the resource allocation and learn how and what practices the government of India is implementing, especially in the Himalayan states. Redesigning these programs

and including local people in the decision-making process may help the program become more credible.

- **Comprehensive inclusion of agricultural and livestock financing while designing adaptation policy.** The GLOF, along with other extreme weather events, are occurring at a higher frequency than ever before in the Himalayan regions. It is important that the government do something for the Himalayan people, whose livelihood is solely dependent on agriculture and livestock. Climate insurance programs, like rural financial institutions at micro and meso level in India, have helped farmers become more resilient. [1]Introducing similar financing mechanisms are crucial in building resilience in the Himalayan region.

- **Revamp disaster risk reduction policies.** The Himalaya is located in a geographic region that is extremely vulnerable and prone to natural disasters. It is imperative to take measures to mitigate the impact of these disasters. Focusing on disaster risk reduction policies and procedures has led to a new safety and regulation standards on disaster risk management in Peru. As a result of the new regulations on disaster risk management, Peru has implemented several projects that have successfully reduced the impacts of natural disasters, namely GLOFs and earthquakes. In Nepal, the loss of lives and properties are have become regular phenomena in face of climate change. Amendments to the existing ineffective policies related to natural disaster are urgently needed. Developing comprehensive policy with a focus on preparedness, emergency response and

[1] In Mongolia, the index-based livestock insurance has been successful in helping the nomadic herders recover after disasters, making them more resilient.

rescue, rehabilitation, and relief management-related related to natural disaster must be addressed.

- **Improvement in Agricultural Technology:** Development and deployment of appropriate technology can have significant impact in rural development. Being an agrarian country, agricultural technology is relevant and a good point at which to begin. India, along with the help of international donor communities like Consultative Group on International Agricultural Research (CGIAR), has been successful in developing drought-resistant crops. In addition to increasing production, these biotechnologies are tremendously effective in preventing wastage of water. With the help of appropriate technology, Peru has been successful in deploying indigenous technology that have proven to be ecologically sound, stable, affordable, and resilient. Nepal has the ability to follow in the footsteps of India and Peru in developing and deploying technology in the rural areas. For instance, focusing on adopting new technologies that are effective under changing climate either by investing in new effective ways through research and experimentation in Peru or engaging international community like India. Improving technology in agricultural sectors will increase the yields of crops, reduce costs of production, and provide food security to the vulnerable population of Himalayas. Apart from economic benefits, the people of the Himalayan region will increase their adaptive capacity, hence becoming more resilient in the process.

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